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# GC-MS and FT-IR Analysis of Methanol Crude Extract of *Parinari curatellifolia*

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## ABSTRACT

The present study aimed to analyze the bioactive constituents of the leaf of *Parinari curatellifolia.* The methanol leaf extracts of the plant were subjected to Fourier Transform Infrared Spectroscopy (FT-IR) and Gas Chromatography-Mass Spectrometry (GC-MS) analysis. The functional groups of the isolated compounds were analyzed using a Bruker Alpha FTIR instrument (Software Opus 6.5). The GC-MS analysis of the methanolic leaf extract of *Parinari curatellifolia* was performed on a Hewlett-Packard GC–MS system (GC 5890 series II; MSD 5971A) and interpreted using the mass spectrum database of the National Institute of Standards and Technology (NIST). The FTIR absorption spectrum of the Methanolic Leaf Extract of *Parinari curatellifolia* exhibited absorptions at 1058.21, 1203.39, 1365.71, 1450.73, 1621.00, 1741.42, 2350.59, 2867.26, 2931.21, 3429.32, and 3794.38 $cm^{-1}$. The characteristic peaks suggest the presence of Aliphatic ether, Alkyl aryl ether, Sulphonamide, Methylene, Conjugated alkenes, Esters, Carbon dioxide, Alkanes, amine salts, and Alcohol groups, respectively. The GC-MS profile of the methanolic leaf extract of *Parinari curatellifolia* showed the presence of 16-Methyloxacyclohexadeca-3,5-dien 2-one; E, E-10,12-Tetradecadien-1-ol acetate; Tricosanoic acid, methyl ester; 1H Imidazole-2-methanol. 1-decyl; 3-Benzo [g] quinoxallin-2yl propanoic acid; 2-Ethylacridine; 9-octadecenoic acid, methyl ester; E-8-Methyl-9-tetradece-1-ol acetate; 2,4-dimethyl Benzo (h) quinoline. This reveals that the plant is highly valuable in medicinal usage for the treatment of various human ailments.

**Keywords:** Phytochemical profile, FT-IR, GC-MS, *Parinari curatellifolia*

## Introduction

Medicinal plant life is a rich source of diverse chemicals with diverse systems and functions, showing significant biological activities and linked to many health benefits, including antimicrobial, anticancer, antiviral, antioxidant, enzyme inhibition, antiaging, antihypertensive, neuroprotective, and anticoagulant effects (Alamgir, 2018; Sarwar *et al.*, 2025). They hold

exceptional global significance, both as standalone remedies and as dietary supplements to traditional medicinal drugs. The substantial evidence of their healing properties, along with long-standing traditional use, has expanded interest in natural products (Latif and Nawaz, 2025). *Parinari curatellifolia*, an evergreen tropical tree native to Africa, is commonly found in deciduous woodlands, particularly in poorly drained inland areas at low altitudes. Its tasty fruit often persists even after the woodland is cleared for agriculture (Yakubu *et al.*, 2012). This plant is a traditional food source in Africa; its fruit can enhance nutrition, improve meal safety, promote rural development, and support sustainable land use (Msangi, 2014). The wood is very dense and suitable for making charcoal. The fruit appears early in the dry season and can be harvested over several months. It's often eaten as a snack and is high in oil content. The beaten pulp is used in drinks, and due to its fermentability, it is regularly employed in producing alcoholic drinks (Matei, 2017). *Parinari curatellifolia* is also valued medicinally, with various components used by traditional herbalists to treat several health issues. For instance, chewed sticks are used for dental hygiene; beaten roots blended with warm water are used to treat constipation; and it's used in managing high blood pressure, diabetes, and liver ailments (Maroyi, 2011; Olaleye *et al.,* 2014).



## Materials and Methods

### Collection of Plant Material and Extraction

Plants were collected from local medicinal practitioners and indigenous herbal vendors located in southeastern Nigeria. Experts in the botany department of the University of Nigeria, Nsukka, classified specimens. A sample of plant matter underwent natural drying in the atmosphere before undergoing extraction using methanol according to conventional procedures outlined by Harborne

(1973) and Sofowora (1982). In summary, the plant underwent brief drying in the presence of air before being crushed using a miller's equipment. A powder specimen underwent extraction using methanol through the application of a Soxhlet extractor. Subsequently, the solution underwent concentration until it reached dryness, at which point residual materials were gathered through the use of a rotary evaporator. A raw sample was kept aside for subsequent examination.

**Fourier Transform Infra-Red Spectroscopy**

The functional groups of the isolated compounds were analyzed using a Bruker Alpha FTIR instrument (Software Opus 6.5) as described by Malm *et al*. (2020). One milligram (1mg) of isolated bioactive compound was mixed with 100mg of potassium bromide, and the mixture was compressed to prepare a small pellet. This pellet was analyzed under an FT-IR spectrophotometer in the range of 349.053-7800.65$cm^{-1}$ at room temperature.



**Gas Chromatography-Mass Spectrometry (GC-MS) of Methanolic Leaf Extract of *Parinari curatellifolia***

The GC-MS analysis of the methanolic leaf extract of *Parinari curatellifolia* was run on a Hewlett-Packard GC–MS system (GC 5890 series II; MSD 5971A, Hewlett-Packard) as described by El-Beltagi *et al* (2019). The fused-silica HP-20 M polyethylene glycol column (50 m x 0.2 mm, 0.2 mm thickness, Hewlett-Packard) was directly coupled to the mass spectrometer. The carrier gas was helium (1ml/min). The program used was 4 min isothermal at 70ºC and 40ºC /min to 180ºC and 10min isothermal. The injection pot temperature was 250ºC and the detector temperature was 280ºC. Ionization of the sample components was performed in the EI mode (70eV).

## Result and Discussion

The FTIR absorption spectra of Methanolic Leaf Extract of *Parinari curatellifolia* (figure 1) exhibited absorptions at 1058.21, 1203.39, 1365.71, 1450.73, 1621.00, 1741.42, 2350.59, 2867.26,

2931.21, 3429.32, 3794.38cm$^{-1}$. Table 1 summarizes the FTIR absorption spectra, class of compound, and functional group of compounds in the Ethyl Acetate Partition of Methanolic Leaf Extract of *Parinari curatellifolia*. The characteristic peaks suggest the presence of the following groups, respectively: Aliphatic ether, Alkyl aryl ether, Sulphonamide, Methylene, Conjugated alkenes, Esters, Carbon dioxide, Alkane, Amine salt, and Alcohol.

Ethers are vital in medicine and pharmacology, especially for use as anesthetics. Sulfonamide (or sulphonamide) functional group chemistry (SN) forms the basis of several groups of drugs. In vivo, sulfonamides exhibit various pharmacological activities, consisting of anti-carbonic anhydrase and anti-t dihydropteroate synthetase, permitting them to play a role in treating a numerous variety of disease states, consisting of diuresis, hypoglycemia, thyroiditis, inflammation, and glaucoma. Sulfamethazine (SMZ) is a generally used sulphonamide drug in veterinary medicine that acts as an antibacterial compound to deal with farm animals' diseases, which include gastrointestinal and respiratory tract infections. Sulfadiazine (SDZ) is another regularly employed sulphonamide drug that is utilized in combination with the anti-malarial drug pyrimethamine to treat toxoplasmosis in warm-blooded animals. Methylene has been used to enhance hepatopulmonary syndrome. Conjugated alkenes which include dienes and polyenes, have a range of applications as pharmaceutical agents and valuable building blocks in the polymer industry (Messiha *et al*., 2021). Amine salts are very essential in medicinal chemistry, and any quantity of legal (and illegal) drugs contains the amine salt functional group. The cause for that is water solubility; a water-soluble molecule is more easily taken in by the human body and is more bioavailable than a water-insoluble molecule (Rocha, 2023).

The Presence of a large proportion of alkenes in the isolate of the Plant has been investigated. It is well-known that plant samples having biochemicals of the alkene group are used as an antiseptic for external use. The presence of an alkene group in the isolate of *Parinari curatellifolia* leaf

extract indicates it might have good antiseptic properties. Alkanes, on the other hand, are present in more or less all biological organisms. It confers ecological and metabolic functions by providing a source of carbon and energy. Amines are an important part of amino acids, building blocks of the proteins of living beings. So, the amino group plays an important role in both plants and animals (Kumar *et al*., 2017).

Imidazole has occupied a unique position in heterocyclic chemistry, and its derivatives have garnered considerable interest in recent years due to their versatile properties in chemistry and pharmacology. Imidazole is a nitrogen-containing heterocyclic ring that possesses biological and pharmaceutical importance. Thus, imidazole compounds have been an interesting source for researchers for more than a century. The imidazole ring is a constituent of several important natural products, including purine, histamine, histidine, and nucleic acids. Being a polar and ionizable aromatic compound, it enhances the pharmacokinetic characteristics of lead molecules and is therefore used as a remedy to optimize solubility and bioavailability parameters of proposed poorly soluble lead molecules. The imidazole derivatives possess an extensive spectrum of biological activities such as antibacterial, anticancer, antitubercular, antifungal, analgesic, and anti-HIV activities (Verma *et al.,* 2013).

The derivatives of acridine have been found to show bio-activities, such as anticancer, antitubercular, antiviral, antimalarial, antimicrobial, anti-inflammatory, antiparasitic, and fungicidal activities. 9-octadecenoic acid (Z)-methyl ester also has antimicrobial, anti-inflammatory, antiandrogenic, and anemia-genic properties (Goni *et al*., 2022).

The GC-MS profile of the methanolic leaf extract of *Parinari curatellifolia* (Table 2) showed the presence of 16-Methyloxacyclohexadeca-3,5-dien 2-one; E, E-10,12-Tetradecadien-1-ol acetate; Tricosanoic acid, methyl ester; 1H Imidazole-2-methanol. 1-decyl; 3-Benzo [g] quinoxallin-2yl

propanoic acid; 2-Ethylacridine; 9-octadecenoic acid, methyl ester; E-8-Methyl-9-tetradece-1-ol acetate; 2,4-dimethyl Benzo (h) quinoline.

16-Methyloxacyclohexadeca-3,5-dien-2-one, also known as cis-muconic acid, has potential medicinal properties, particularly in cancer treatment and as an antioxidant, according to some studies. It has been identified in certain medicinal plants and extracts, and its presence has been associated with various pharmacological activities. Tricosanoic acid, a long-chain saturated fatty acid, has shown potential medicinal properties related to reducing inflammation and potentially impacting cognitive function (Shen, 2024). It's also been investigated for its potential antimicrobial and hair growth-stimulating properties. Methyl esters, a class of organic compounds, exhibit a range of medicinal properties, including anti-inflammatory, antifungal, and antioxidant effects. They are also known for their potential as neuroprotective agents and for their ability to reduce oxidative stress. Some methyl esters, like gallic acid methyl ester, demonstrate anti-HIV and antitumor activities (Ng *et al*., 2018). Others, such as fatty acid methyl esters, show promise in treating cerebral ischemia.



1H-Imidazole-2-methanol is a compound with potential medicinal properties due to its imidazole ring structure. It has shown activity against bacteria and fungi, and some derivatives exhibit anticancer activity. The compound's ability to interact with enzymes and biological molecules makes it a candidate for drug development. Quinoxaline derivatives have been recognized for their diverse biological activities, particularly in the realm of anti-cancer and anti-viral research. Some quinoxaline-based compounds have shown promise as inhibitors of reverse transcriptase (RT) in HIV-1 replication. Additionally, quinoxaline-1,4-di-N-oxide derivatives have been investigated for their potential antitumor, anti-inflammatory, and anti-infectious properties. 2-Ethylacridine is a chemical compound that has shown potential medicinal properties, particularly in the areas of antimicrobial and anticancer activity. It has been identified as an antibacterial agent and is also

being explored for its potential antitumor properties. 9-Octadecenoic acid, commonly known as oleic acid, is a monounsaturated omega-9 fatty acid with several potential medicinal properties. It exhibits anti-inflammatory, antioxidant, and anti-diarrheal effects, and is also involved in lipid metabolism and membrane structure. 2,4-Dimethylbenz [h]quinoline, a quinoline derivative, exhibits several medicinal properties, primarily as an antimicrobial and antifungal agent (Senerovic *et al.,* 2019). Research indicates it also possesses DNA-binding, wound-healing, and antioxidant activities.

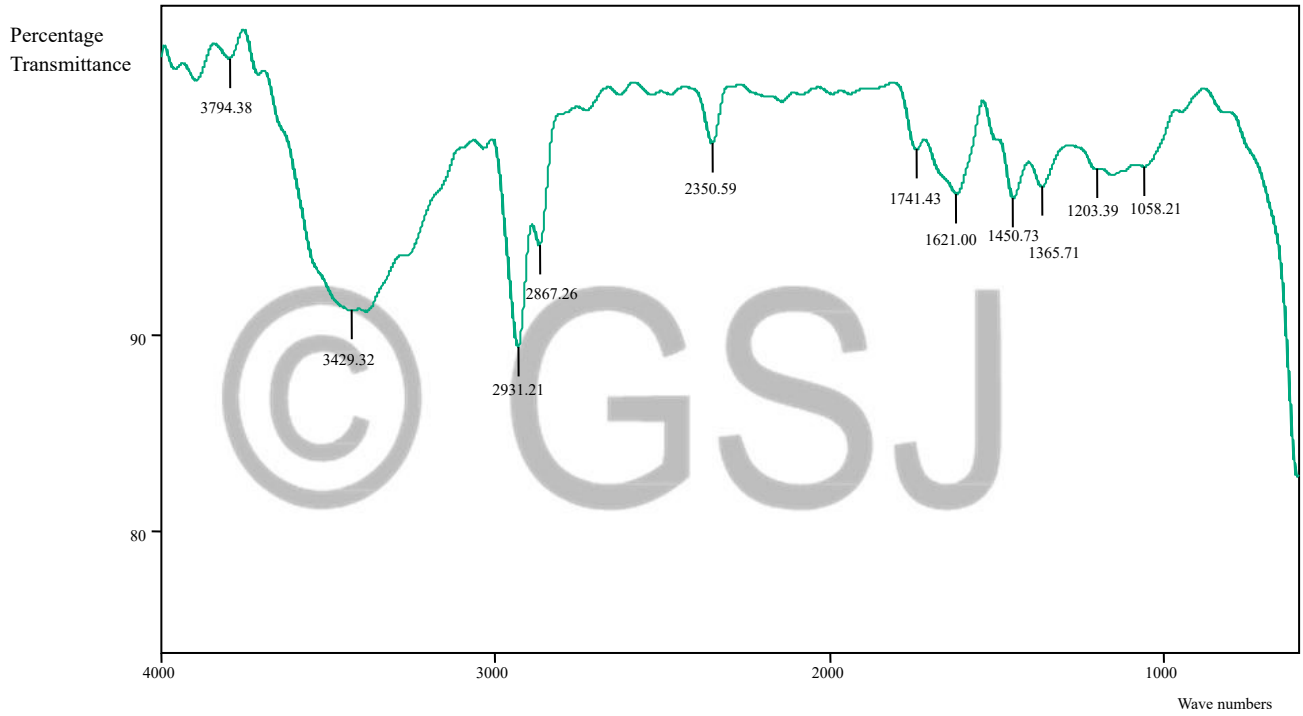


**Figure 1: FT-IR spectrum of the methanol leaf extract of *Parinari curatellifolia***

**Table 1:** FTIR of Methanol Leaf Extract of *Parinari curatellifolia*

| Class of compound | Functional group | Absorption $cm^{-1}$ | Peak height | Appearance |
|---|---|---|---|---|
| Aliphatic ether | C-O stretching | 1058.21 | 99.12 | Strong |
| Alkyl aryl ether | C-O stretching | 1203.39 | 98.94 | Strong |

| | | | | |
|---|---|---|---|---|
| Sulphonamide | S=O stretching | 1365.71 | 98.06 | Strong |
| Methylene | C=H bend | 1450.73 | 97.48 | medium |
| Conjugated alkenes | C=C stretching | 1621.00 | 97.71 | Medium |
| Esters | C=O stretching | 1741.43 | 99.96 | Strong |
| Carbon dioxide | O=C=O stretching | 2350.59 | 100.30 | Strong |
| Alkane | C-H stretching | 2867.26 | 95.09 | Medium |
| Amine salt | N-H stretching | 2931.21 | 89.91 | Strong, broad |
| Alcohol | O-H stretching | 3429.32 | 91.76 | Strong, broad |
| Alcohol | O-H stretching | 3794.38 | 104.60 | Strong, broad |

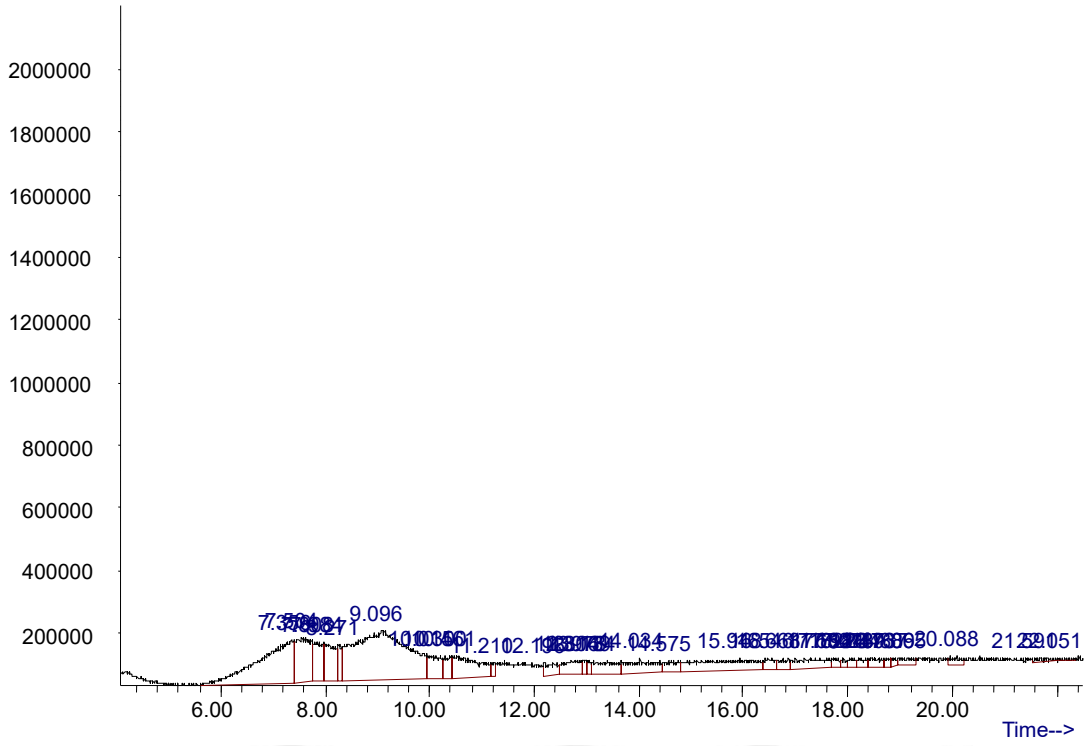


**Figure 2:** GC - MS chromatogram of Methanol Leaf Extract of *Parinari curatellifolia*

**Table 2:** GC-MS Profile of the Methanolic Leaf Extract of *Parinari curatellifolia*

| S/N | RT | COMPOUND | MW | Molecular Formula |
|---|---|---|---|---|
| **1** | 7.806 | Cinnamic acid, p- (trimethyl siloxy) -, methyl ester | 250.37 | $C_{13}H_{18}O_3Si$ |
| **2** | 9.095 | 16-Methyloxacyclohexadeca-3,5-dien -2-one | 250.38 | $C_{16}H_{26}O_2$ |
| **3** | 10.294 | E, E-10,12-Tetradecadien-1-ol acetate | 252.39 | $C_{16}H_{28}O_2$ |
| **4** | 10.457 | Tricosanoic acid, methyl ester | 368.6 | $C_{24}H_{48}O_2$ |
| **5** | 14.568 | 1H-Imidazole-2-methanol. 1-decyl | 238.37 | $C_{14}H_{26}N_2O$ |
| **6** | 15.938 | 3-Benzo [g] quinoxallin-2yl propanoic acid | 252.27 | $C_{15}H_{12}N_2O_2$ |
| **7** | 16.538 | 2-Ethylacridine | 207.27 | $C_{15}H_{13}N$ |
| **8** | 17.141 | Beta amyrin acetate | 426.7 | $C_{30}H_{50}O$ |
| **9** | 18.723 | 9-octadecenoic acid, methyl ester | 296.5 | $C_{19}H_{36}O_2$ |

| | | | | |
|---|---|---|---|---|
| **10** | 20.982 | E-8-Methyl-9-tetradece-1-ol acetate | 268.4 | $C_{17}H_{32}O_2$ |
| **11** | 22.034 | 2,4-dimethyl Benzo (h) quinoline | 207.27 | $C_{15}H_{13}N$ |

## Conclusion

Natural products have fewer side effects and have been used to cure diseases effectively since ancient times. It can be concluded that phytochemicals were observed in the methanol leaf extract of *Parinari curatellifolia,* which reveals that this plant is highly valuable in medicinal usage for the treatment of various human ailments.

**CONFLICT OF INTEREST:** The authors declare that there was no conflict of interest.



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